

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Conf. No.: 3955

Stephen Buchwalter et al.

Serial No.: 09/801,655

Art Unit: 2827

Filed: March 9, 2001

Examiner: Luan C. Thai

For: Reworkable and Thermally
Conductive Adhesive and Use
Thereof

Atty Docket: YOR92000330US1

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D. EVANS
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RESPONSE AND AMENDMENT UNDER 37 CFR § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated March 13, 2002, please amend the above-captioned application as follows:

IN THE CLAIMS:

Please amend the claims as follows.

AI
10. (Amended) The packaging structure of claim 8 where the thixotropic agent comprises silica or siloxane-coated fumed silica.

REMARKS

Claims 1-35 are now in the application. Claims 1-15 and 28-35 are drawn to the elected invention. Claims 16-27 are drawn to non-elected invention and may be cancelled by the Examiner upon the allowance of the claims directed to the elected invention.

Claim 10 has been amended to change its dependency to claim 8 for purposes of clarification.

The rejection of claims 10-11 and 28-35 under 35 USC 112, second paragraph has been overcome by the amendment to claim 10 and/or is not deemed tenable. In particular, claim 10 now depends from claim 8 which thereby provides antecedent basis for the term "the thixotropic agent". The use of the term "weight" in claims 11 and 12 is not unclear and would be readily apparent to those skilled in the art that the weight percents are those based upon actually weighing the components when preparing the compositions. Typically, when presenting percentages of a composition, such are either presented as weight or volume percents. The rejection of claims 29-35 as including the limitations of independent claim 28 is not deemed tenable. In particular, claims 29-35 recite additional limitations more specific than those explicitly stated in claim 28. Accordingly, claims 29-35 are proper dependent claims from claim 28.

Claims 1-5, 8, 10, 12 and 13 were rejected under 35 USC 103(a) as being unpatentable over U.S. Patent 5,468,995 to Higgins in combination with U.S. Patent 5,512,613 to Ardakani et al. The cited references do not render obvious the present invention.

In particular, the present invention relates to microelectronic packaging structures and particularly to packaging structures that include bonding the semiconductor device to a chip carrier or heat spreader employing a reworkable and thermally conductive adhesive. A very common method of interconnecting a semiconductor dye to other devices uses an adhesive, referred to as a dye attached adhesive, to bond the passive or backside of the dye to a substrate containing interconnect wiring (referred to as a chip carrier). The dye is also electrically connected to the chip carrier with wire bonds from peripheral I/O pads on the dye to corresponding pads on the carrier. The dye attached adhesive must be cured prior to the wire bonding operation to make certain that the chip does not move during wire bonding. With the usual dye attached adhesives, rework of a misaligned or defective chip, or one on which a wire bonding defect has been found by inspection, is then impossible because the adhesive is an insoluble thermoset plastic.

This is a significant limitation because partially satisfactory assemblies cannot be reworked to recover the value of the good components of the assembly.

Although thermoplastic dye attached adhesives have been used for reworkability, their adhesive characteristics are inferior to the more preferred thermoset materials used for this purpose. Furthermore, the thermoplastic materials exhibit certain process disadvantages over a thermoset. In one case, the thermoplastic is a paste which is dissolved in a solvent. If the dye is placed before solvent evaporation, there will be a large amount of voids in the bond line after bonding. On the other hand, if the solvent is evaporated prior to dye placement, then there is a firm thermoplastic bump/solid that will require chip placement under heat and pressure for some time to accomplish bonding. It is difficult to achieve relatively thin bond lines, typical of dye attach processing, with a dried thermoplastic bump. Also, the thermoplastic resists flow because of its inherently much larger molecular weight as compared to an uncured thermoset monomer and in combination with a very high filler loading become even more difficult to spread.

The present invention provides for an adhesive that is reworkable along with making it possible to provide a bond line that is void-free or free from air entrapment. As shown in the specification (see Fig. 3 and page 11, lines 1-5), the present invention also results in very limited spreading of the adhesive beyond the chip site.

U.S. Patent 5,468,995 to Higgins does not suggest the present invention since, among other things, Higgins, as appreciated by the Examiner, fails to teach an adhesive comprising a cured reaction product from a diepoxide and cyclic anhydride wherein the epoxy groups are connected through an acyclic acetal moiety; and a thermally conductive filler. In addition, Higgins fails to suggest achieving a void-free, thin bond-line between the chip and chip carrier, along with providing a reworkable adhesive as achieved by the present invention.

Ardakani et al fail to overcome the above-discussed deficiencies of Higgins with respect to rendering obvious the present invention. In particular, Ardakani et al fail to suggest that the diepoxide materials disclosed therein in admixture with a filler could be used in the type of structure required by the present invention to achieve a void-free thin-

bond line between the chip and chip carrier, as well as being reworkable. Moreover, Ardakani et al fail to explicitly disclose that fillers must be thermally conductive as required by the present invention. Accordingly, persons skilled in the art, faced with the problems discussed above, would not be motivated by Ardakani et al to employ a composition containing the particular epoxy resins disclosed therein, along with thermally conductive filler, and expect with any degree of predictability that these problems would be successfully overcome.

Claims 6-7 and 9 were rejected under 35 USC 103(a) as being unpatentable over U.S. Patent 5,468,995 to Higgins in combination with U.S. Patent 5,512,613 to Ardakani et al and further in view of U.S. Patent 5,844,309 to Takigawa et al. The above discussion of Higgins and Ardakani et al is incorporated herein by reference.

Takigawa et al were relied upon for a disclosure of thermally conductive fillers such as aluminum nitride and various electrically conductive fillers. However, Takigawa et al do not overcome the above-discussed deficiencies of Higgins and Ardakani et al with respect to rendering obvious the present invention. Accordingly, claims 6, 7 and 9 are patentable for at least those reasons as to why the generic claims are patentable.

Claims 14 and 15 were rejected under 35 USC 103(a) as being unpatentable over U.S. Patent 5,468,995 to Higgins in combination with U.S. Patent 5,512,613 to Ardakani et al and further in view of U.S. Patent 5,471,027 to Call et al. The above discussion of Higgins and Ardakani et al is incorporated herein by reference. Call et al was merely relied upon for a disclosure of a heat spreader being bonded to a semiconductor device. However, Call et al fail to overcome the above-discussed deficiencies of Higgins and Ardakani et al with respect to rendering obvious the present invention. Accordingly, claims 14 and 15 are patentable for at least those reasons as to why the generic claims are patentable.

The mere fact that cited art may be modified in the manner suggested by the Examiner does not make this modification obvious, unless the cited art suggest the desirability of the modification. No such suggestion appears in the cited art in this matter. The Examiner's attention is kindly directed to *In re Lee*, 60 USPQ2d 1430

(Fed. Cir. 2002), *In re Dembiczak et al.* 50 USPQ2d. 1614 (Fed. Cir. 1999), *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984), *In re Laskowski*, 10 USPQ2d. 1397 (Fed. Cir. 1989) and *In re Fritch*, 23, USPQ2d. 1780 (Fed. Cir. 1992).

In *Dembiczak et al.*, supra, the Court at 1617 stated: “Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references. See, e.g., C.R. Bard, Inc., v. M3 Sys., Inc., 157 F.3d. 1340, 1352, 48 USPQ2d. 1225, 1232 (Fed. Cir. 1998) (describing ‘teaching or suggestion motivation [to combine]’ as in ‘essential evidentiary component of an obviousness holding’), *In re Rouffet*, 149 F.3d 1350, 1359, 47 USPQ2d. 1453, 1459 (Fed. Cir. 1998) (‘the Board must identify specifically...the reasons one of ordinary skill in the art would have been motivated to select the references and combine them’);...”.

Also, the cited art lacks the necessary direction or incentive to those of ordinary skill in the art to render a rejection under 35 USC 103 sustainable. The cited art fails to provide the degree of predictability of success of achieving the properties attainable by the present invention needed to sustain a rejection under 35 USC 103. See *Diversitech Corp. v. Century Steps, Inc.* 7 USPQ2d 1315 (Fed. Cir. 1988), *In re Mercier*, 185 USPQ 774 (CCPA 1975) and *In re Naylor*, 152 USPQ 106 (CCPA 1966).

Moreover, the properties of the subject matter and improvements which are inherent in the claimed subject matter and disclosed in the specification are to be considered when evaluating the question of obviousness under 35 USC 103. See *Gillette Co. v. S.C. Johnson & Son, Inc.*, 16 USPQ2d. 1923 (Fed. Cir. 1990), *In re Antonie*, 195, USPQ 6 (CCPA 1977), *In re Estes*, 164 USPQ (CCPA 1970), and *In re Papesch*, 137 USPQ 43 (CCPA 1963).

No property can be ignored in determining patentability and comparing the claimed invention to the cited art. Along these lines, see *In re Papesch*, supra, *In re*

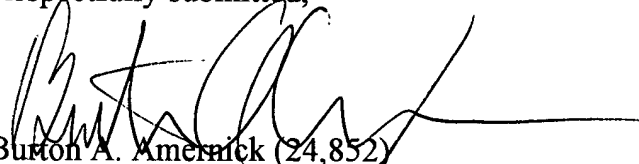
Burt et al, 148 USPQ 548 (CCPA 1966), *In re Ward*, 141 USPQ 227 (CCPA 1964), and *In re Cescon*, 177 USPQ 264 (CCPA 1973).

In view of the above, consideration and allowance are, therefore, respectfully solicited.

In the event the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.

The Director is hereby authorized to charge any fees, or credit any overpayment, associated with this communication, including any extension fees, to CBLH Deposit Account No. 22-0185.

Respectfully submitted,



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